Research Coaching

Horizontal and vertical thinking: teach creativity and enhance it.

"Ninety percent of error in thinking is due to error in perception.
If you can change your perception, you can change your emotion, and this can lead to new ideas."
— Edward de Bono

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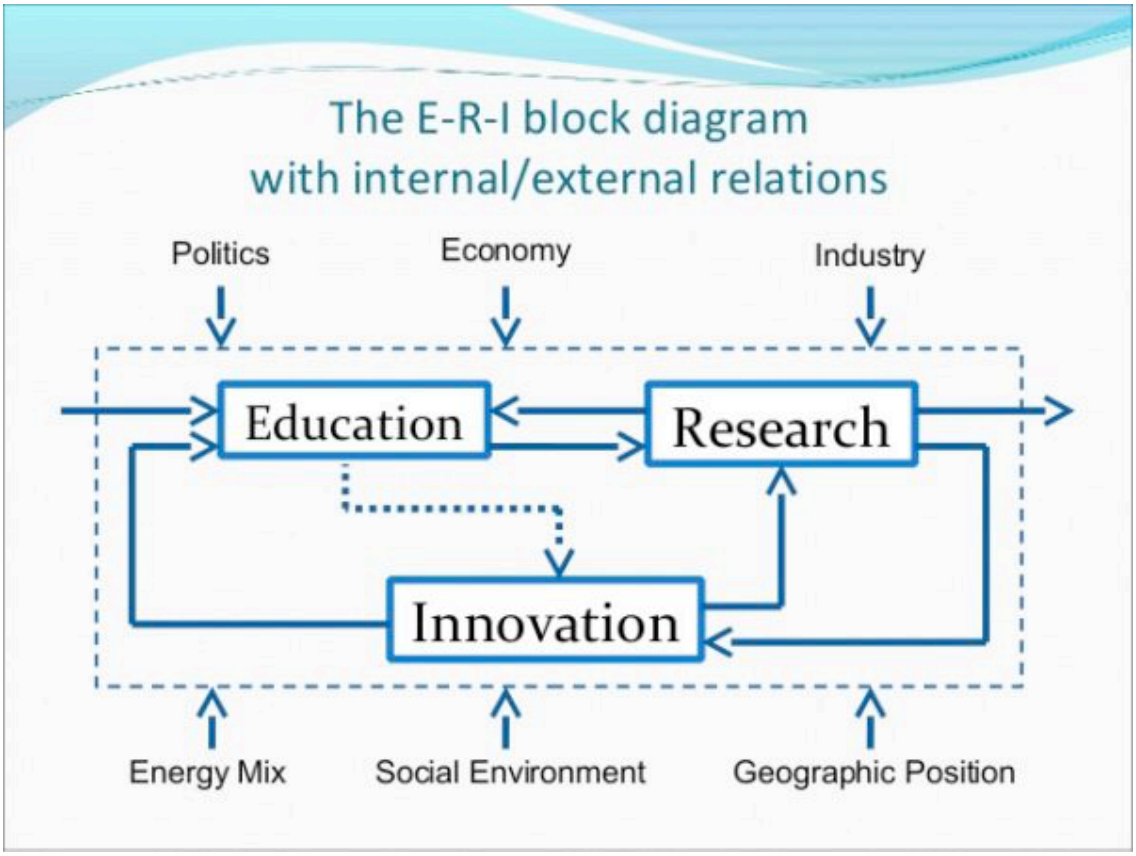
In my previous post, "**Being an Earwig in Astronomy**," I mentioned my plan to approach researchers at the Herzberg Institute for Astrophysics with the idea that they could be using their minds to greater effect. Clearly, there are many ways one can use one's mind. I'd like to offer some clarity regarding how coaching, counseling, and consulting might help accomplish this.

I avoid the word “therapy” because, while there are many useful ideas in a therapist’s toolkit, therapists see dysfunction whether it exists or not. Because of that, therapists are out of the running when the goal is the scientific enhancement, a field that we might call, to coin a phrase, research coaching.



Directional Thinking

People are generally human, though many scientists would like to think of themselves as exceptions. Scientists are subject to the same fallacies, preconceptions, and emotional vagaries as the rest of us. This is a good thing because when emotion is disrespected, morality is lost. Yet, we still see the hold-over of the scientism of the enlightenment—which is not particularly enlightened—that urges the science-minded to believe they have overcome the foibles of feeling, predisposition, and prejudice. This arrogance is alive and well in research today.

Scientists and engineers are taught to be deductive. Like racing dogs, their training in epistemology is nonexistent and they are high strung. Kahnemann and Tversky enlightened narrow thinking neoclassical economists to the fact that people don’t think as economists had assumed. In particular, people are neither reasonable or rational according to the assumptions of economists. What they did not say—though they should have—is that economists are not particularly reasonable or rational either. Let’s make that case, now.

Vertical thinking moves along established lines. More specifically, it’s thinking according to pre-established rules. Vertical thinkers apply the solutions that worked before to new problems, and this works when the problems are the same. Vertical thinkers also think about new problems as they thought about old problems, and when a solution is not forthcoming, they apply greater force in the same direction. Insects are vertical thinkers. Schools teach vertical thinking. The reputations of experts rest on vertical thinking.

Horizontal thinking is creative thinking. More specifically, it boils down to applying the wrong tool for a job in which the right tool doesn’t work. The key to horizontal thinking lies in the notions of right and wrong, which are only well defined from within the vertical mindset. In science, horizontal thinking appears unusual because science always gravitates to a vertical form.

Pachelbel's Cannon in D visualized.
Time proceeds from top, clockwise.

Novelty

People are trained to think vertically because problems are seen in terms of our skills and resources. Vertically conceived goals lead to an exploitative mindset that isn't necessarily bad but is narrow. When we exploit resources to achieve results, we take those resources for granted.

Horizontal thinking is disruptive to the vertical mindset. Novelty mixes media and metaphors and asks the viewer to change direction. In our institutions, education means inculcation and novelty is discouraged but this need not be the case. Novelty is teachable. It is taught in other systems, notably wholistic situations where no one right way prevails.

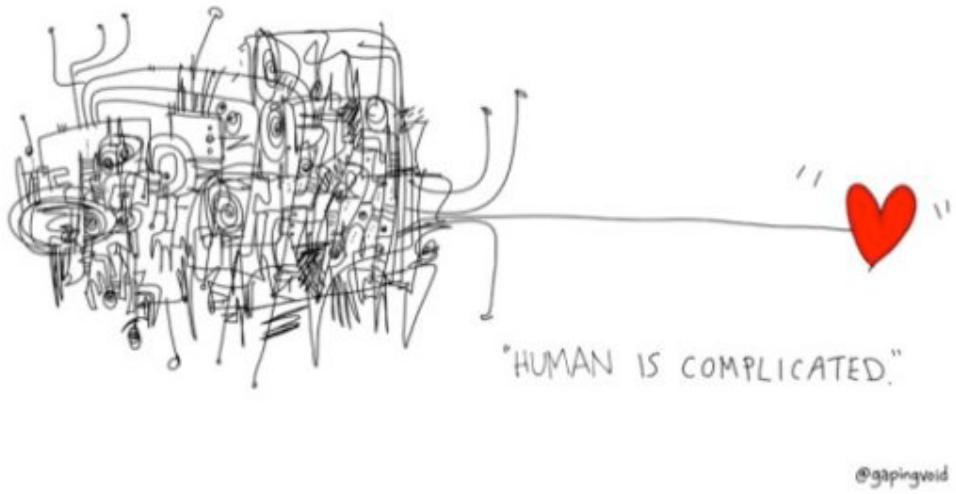
> "Words are encyclopedias of ignorance because they freeze our perceptions at one moment in history and then insist that we continue to use these frozen perceptions when we should be doing better."
> —Edward de Bono

There is something particularly modern about vertical thinking, which should be disturbing because many modern problems are not vertical in nature. Long-standing technical problems are often carefully, vertically presented in a way that highlights their insolvable nature; a sensible invitation to an intractable solution.

It is this tendency of vertical thinking to lead itself into dead ends that leads to paradigm shifts, and one

wonders if such shifts are intrinsic to progress, or specific to vertical thinking. Is vertical thinking anti-evolutionary? Must horizontal thinking be threatening? What are we afraid of?

I'm reminded of the movie *Never Cry Wolf* in which Tyler, a research biologist, attempts to subsist on mice to test the specific research question of whether mice are numerous enough to sustain a large mammal, like himself. He meets an Inuit with a more horizontal interest in survival who comments, upon learning of Tyler's new diet, "Good idea!" To the vertically minded, subsisting on mice is science. To the horizontally minded, it's simply a good idea.



Mixed Modal Thinking

Charlie Townes wanted to observe hot molecules but they melted his oven. The problem was how to get molecules hotter than the melting temperature of the oven that held them?

He recalled that Einstein showed molecules emit radiation when tickled with a specific frequency. From electrical engineering, he also knew that a system undergoing feedback would resonate at a specific frequency. Could he build a machine whose feedback matched his molecule's stimulation frequency? He did this calculation in his head, and the numbers worked.

He combined these two ideas to design a machine that would stimulate molecules to emit radiation. He hoped this would yield large numbers of a specific type of hot molecule, but not so many at other frequencies as would cause the machine to melt.

This was a new idea. Those working with hot molecules didn't know the engineering of feedback systems, and those engineers who did didn't work with hot molecules. He named the new idea "molecular amplification by stimulated emission of radiation."

Considering it further, he thought it would be possible to heat light itself and produce a narrow high-frequency beam. His ideas conflicted with what others thought was possible. In fact, it was considered so absurd it offended his colleagues. He got no support, so he worked alone. He suggested the new machine might be called a laser.

Tinkering With God

Newton was interested in proving the existence of God, and he was going to do this by showing that divine laws governed the motion of planets. He had Kepler's observations but there was no theory behind it. The

problem was made more difficult because planetary motion had no mechanism, so he invented one and called it the calculus. With it, he wrote equations linking a force he called gravity with a property he called mass and showed that God used mathematics to a level of perfection beyond the capability of humans.

Today, Newton's theory of gravitation is taught as an exercise in vertical thinking: we calculate positions using velocities, masses, and forces. This is not the path that Newton took. His thinking was horizontal. It's hard to imagine today how much this work blew people's minds in the 1700s.

Richard Feynman is credited with perfecting the Feynman problem-solving method: State the problem. Think about it. Present the answer. This is quoted as a testament to his genius, but it reflects something deeper: writing down the formalism of a problem to be solved presupposes the form of the answer. This is not the way to go about finding an answer that does not have this form.

In my own work in physics, I looked at particular solutions to the puzzle of interacting atomic magnets. Their behavior, as generated by a computer, showed a simple structure I couldn't see in the original problem. Using an unrealistic rule I worked backward from these solutions to a different starting point, invented a new rule that both retained the simple structure and regained the original problem.

I had found a new solution to the original problem. This trial and error process could have been made easier if I had not been trying so hard. I could have used some help in relaxing so that I could explore without pressure.

Invention

Horizontal thinking generates inventions, but studying the success of these ideas does not tell you how they came to be. We label as works of genius these creations that could not be deduced but there is a fallacy here: creativity can be taught, we just don't do it. These inventors and their inventions are unusual, but is that necessary?

In counseling and therapy, I rearrange my clients' perceptions. Combining the logical and illogical generates new information, issues, and approaches. Implausible ideas harbor novelty in the way that shape-shifters cross boundaries. Shape-shifters are ubiquitous in the mythology of older cultures, but not in ours.

I suggest technical problems have this in common with personal problems. It's not that I expect to solve technical problems any more than I solve personal problems, it's that I expect they are the wrong problems. It is possible to facilitate the rearrangement of another person's problem, their vision of themselves, and the tools they've brought to bear, to build a larger picture, with different players, rhythms, points of view, and goals. Major personal problems are rarely resolved, they are dissolved.

> "There is one established fact which remains unchangeable. The client has the answers to all of his or her own problems. The solution lies within each person. It is the therapist's job to assist in the discovery."
> —William Baldwin, in *Spirit Releasement Therapy*.

I want researchers to imagine the form of a solution before they have one. Working backward from a solution to a different problem. From a sense of resolution, which is essentially viewing the problem from the vantage point of it's already being solved, what previously appeared irrelevant now plays a role.

> "I'm a garbage picker-upper as a mode of science: I focus on the garbage truck. I look at the parts that others choose not to pay attention to. It's interesting the number of things that are not paid attention to… absolutely astounding."
> —Jerry Lettvin, neurophysiologist, in ***The Learning Project, Rites of Passage***

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Lincoln Stoller 2019-08-11